Silicon SeaBelt 2.0: Challenges of Kyushu for Reproduction of Silicon Island

Oct 24, 2024

Kyushu Semiconductor Human Resource Development Consortium WG Chair

Hiroto Yasuura

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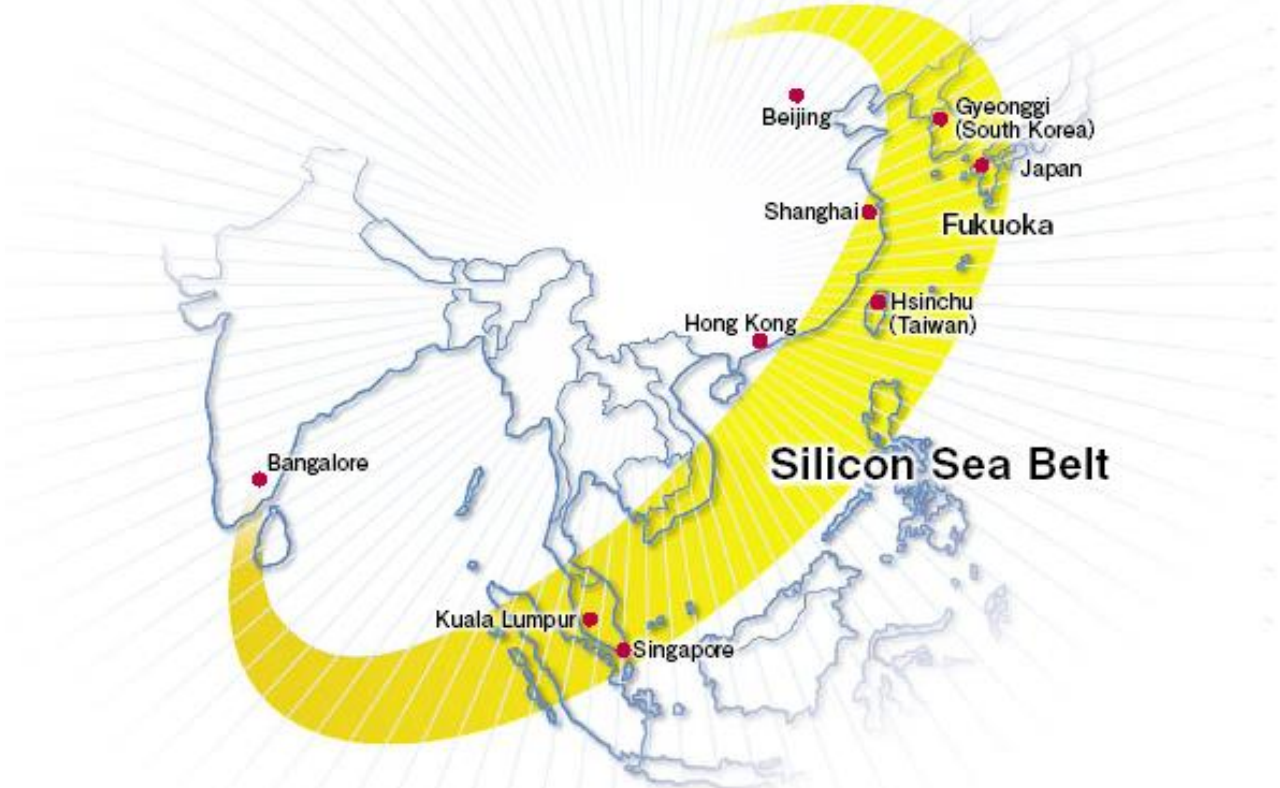
1. Silicon SeaBelt and Kyushu

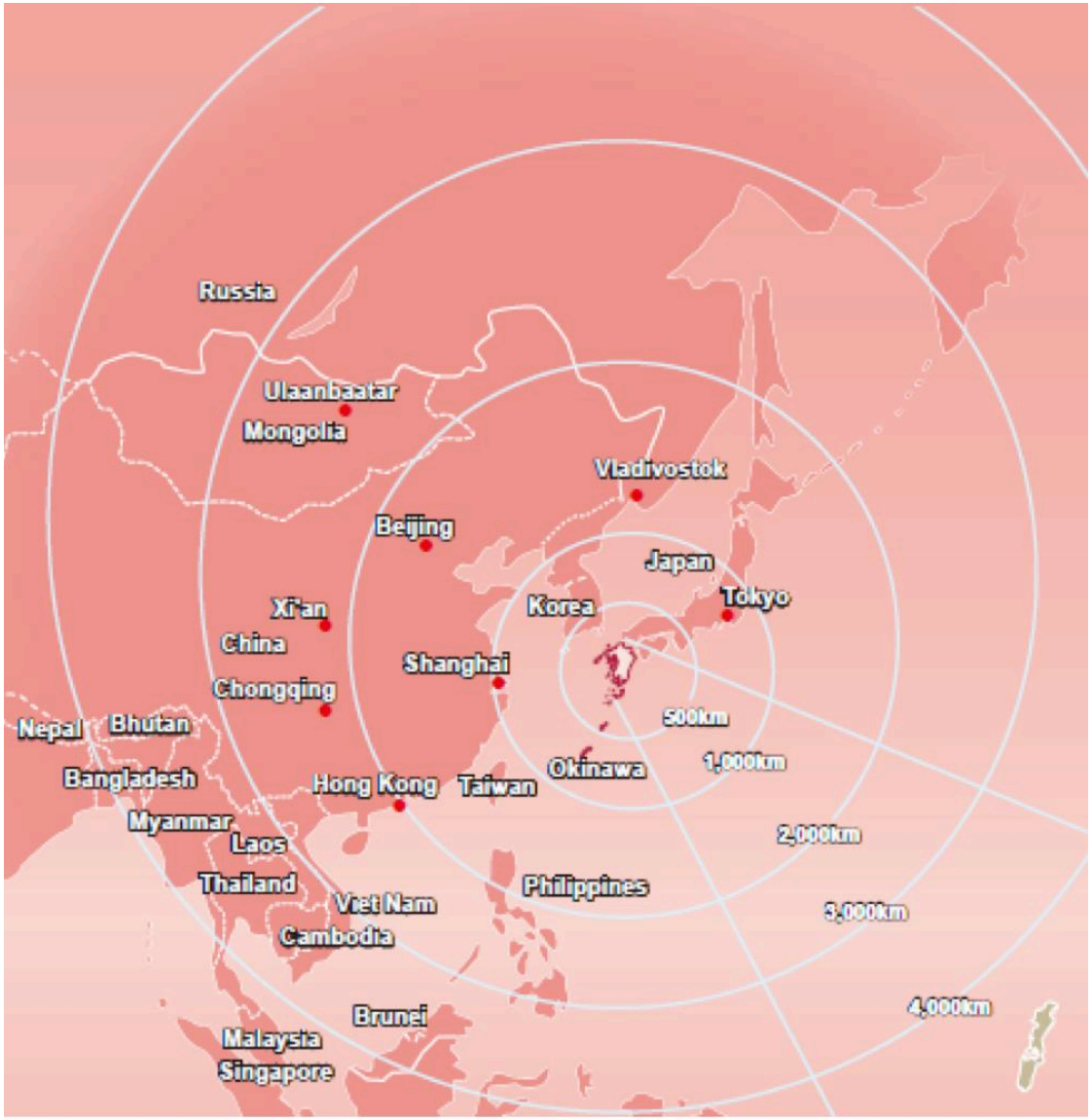


Kyushu and Fukuoka

Fukuoka (Kyushu) is located at the center of East Asian cities.

500km: Osaka and Seoul
1000km: Tokyo, Shanghai and Dalian
1500km: Sapporo, Taipei and Beijing

More than 70% of Semiconductor Products of the world are produced in this Area.

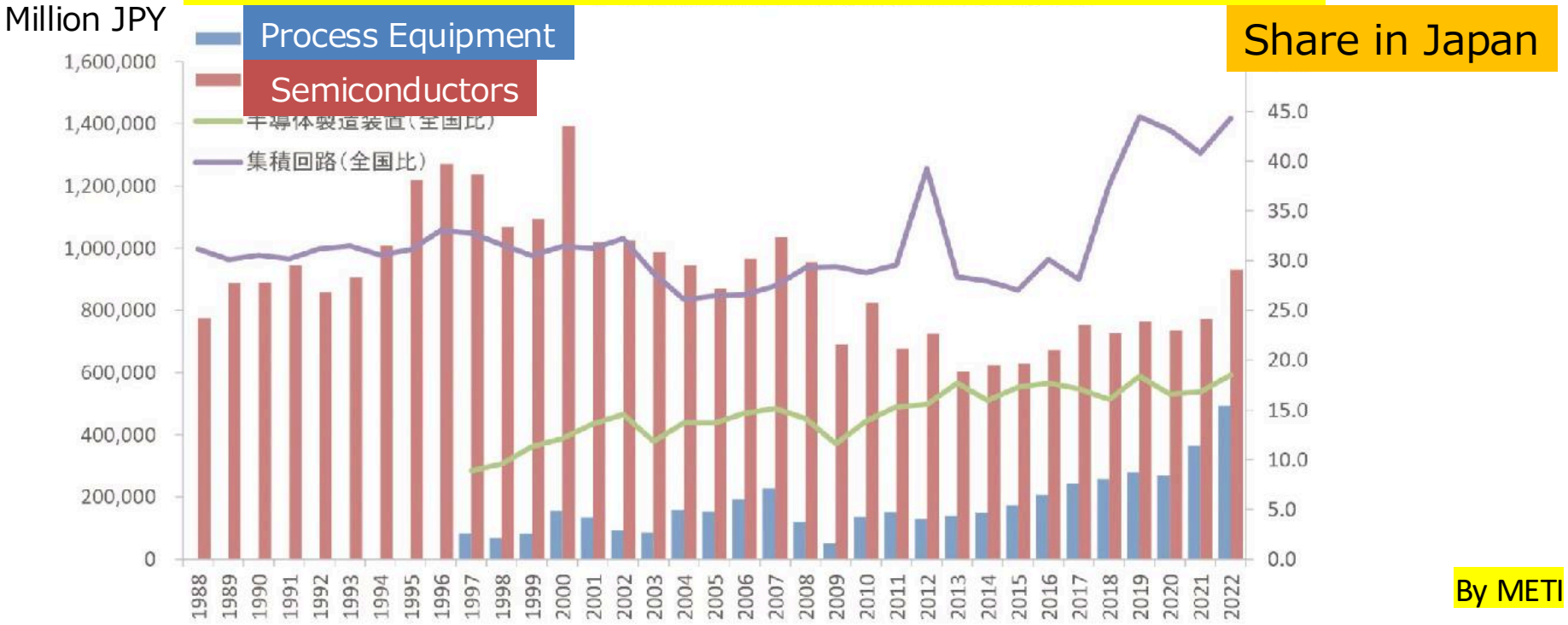


Kyushu was called Silicon Island in 80's to 90's

1970-2000
- Semiconductor Production Center of Japan
  - Memories (SRAM and DRAM)
  - Logic

After 2000
- CMOS Image Sensors
- Power Semiconductor
- Manufacturing Equipment
- Materials
- 1,000 related companies

Semiconductor and Process Equipment Production in Kyushu



By METI

Now Silicon Island is Taiwan

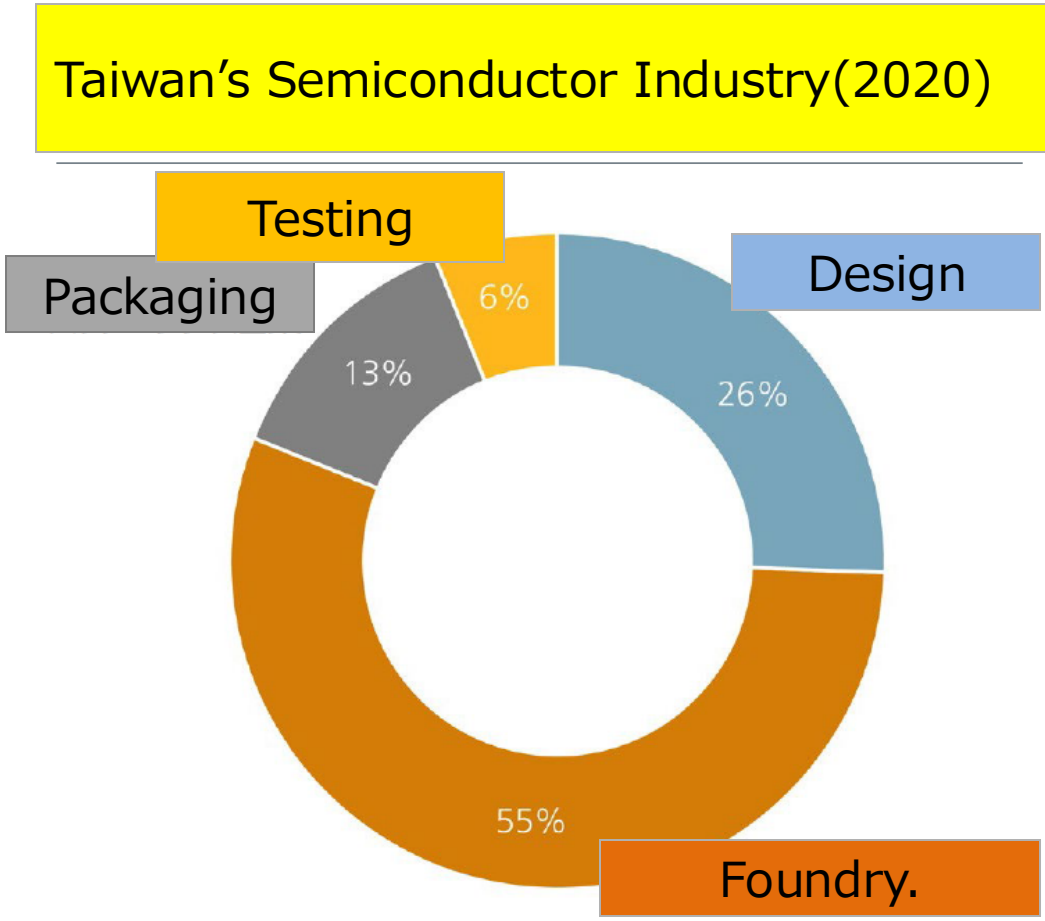
36,000km²	**Area**	42,000km²
23.5M	**Population**	12.6M
775B USD	**GDP**	440B USD
Semiconductor		
60.7B USD	**Production**	7.4B USD

30 years ago, production of semiconductors of Kyushu was about 10 times larger than Taiwan.

Strategy of Taiwan

Taiwan's share of over 30% in world's key industry is a major strength for national security.

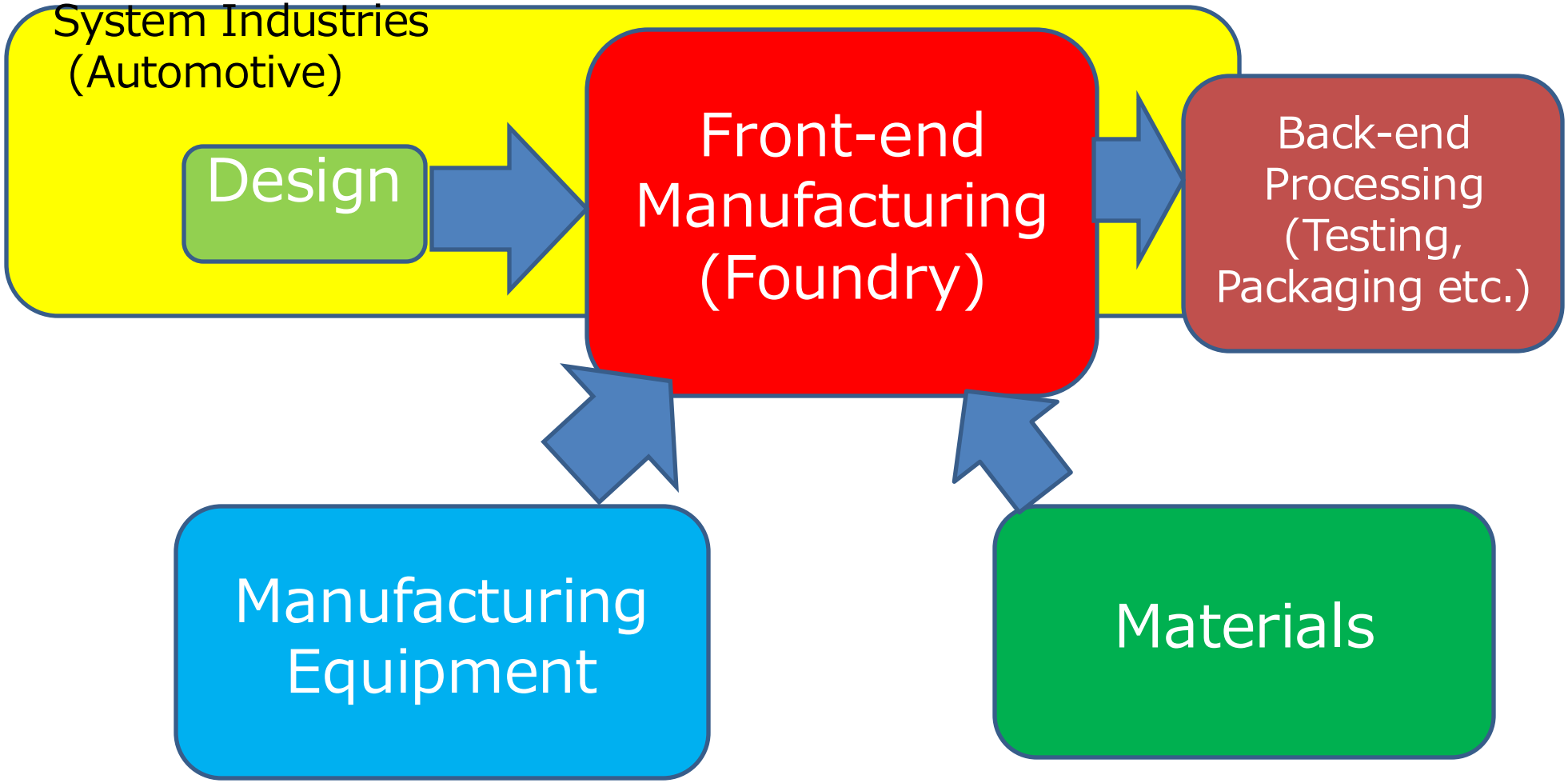
Changes of the Key Industries
1980-1990's
Mother Board of PC: Labor Intensive
1995-
Silicon Foundry : Technology and Capital Intensive
2000-
IC Design : Knowledge Intensive



出所：台湾半導体産業協会（TSIA）発行のレポート「Overview on Taiwan Semiconductor Industry (2020Edition).」

Supply Chain in Kyushu

Kyushu was called a Brainless Silicon Island!



Silicon SeaBelt Project (2002-2010)

Develop a new semiconductor **design industry cluster** in Kyushu and create a global industrial cluster area for the **usage, design, and manufacture of semiconductors**, extending to **Korea, Kyushu, Taiwan, China, South East Asia, Singapore, and India.**

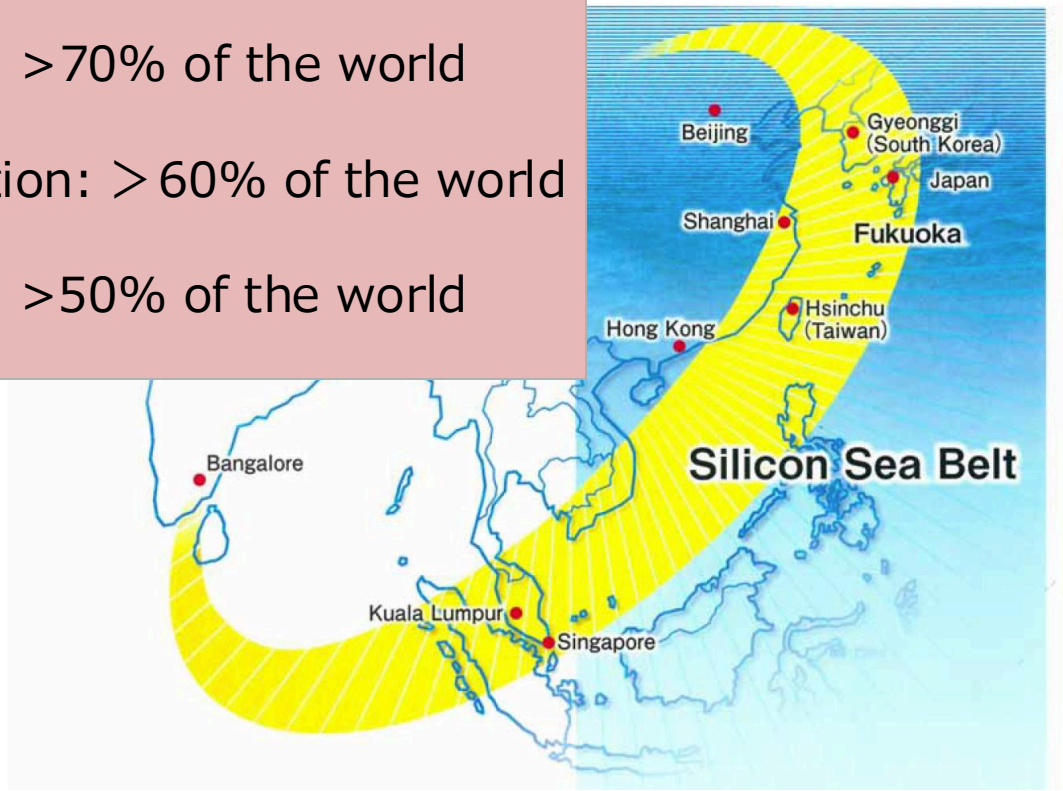
-Gov. Wataru Aso of Fukuoka Pref.

Silicon SeaBelt

Market: >70% of the world

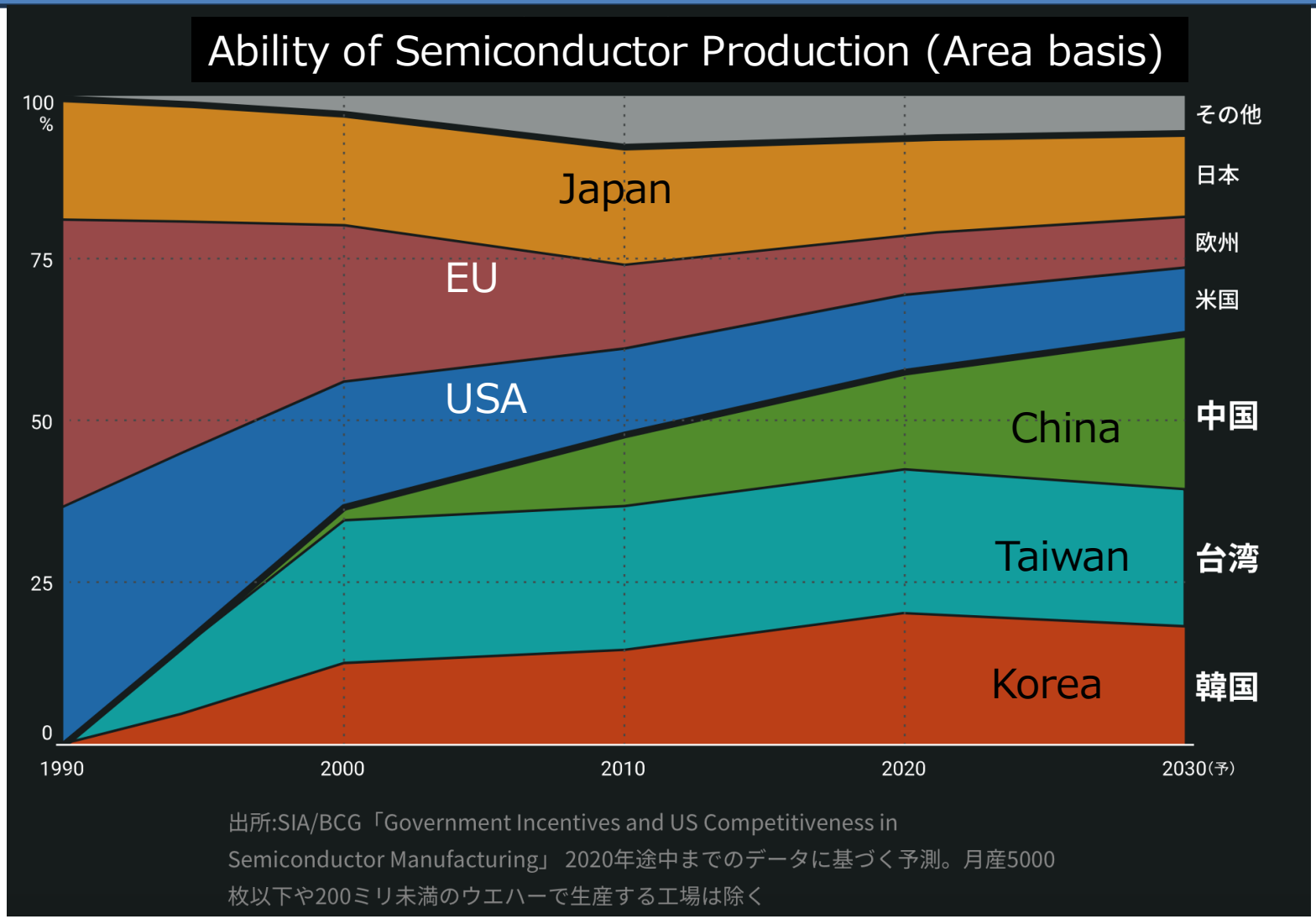
Production: ＞60% of the world

Design: >50% of the world



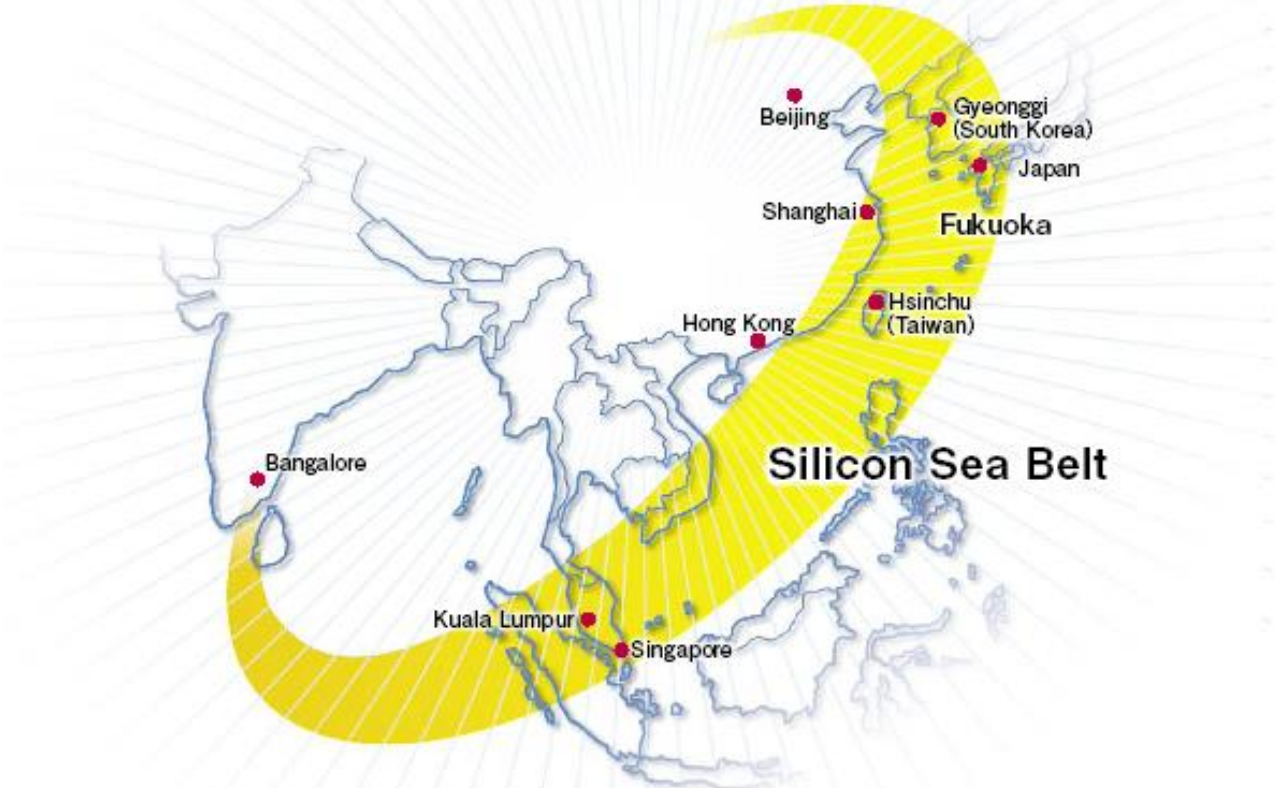
More than 250 companies gathered

Silicon SeaBelt has been realized



By Nikkei

2. Why Kyushu lost the position in the semiconductor industry?



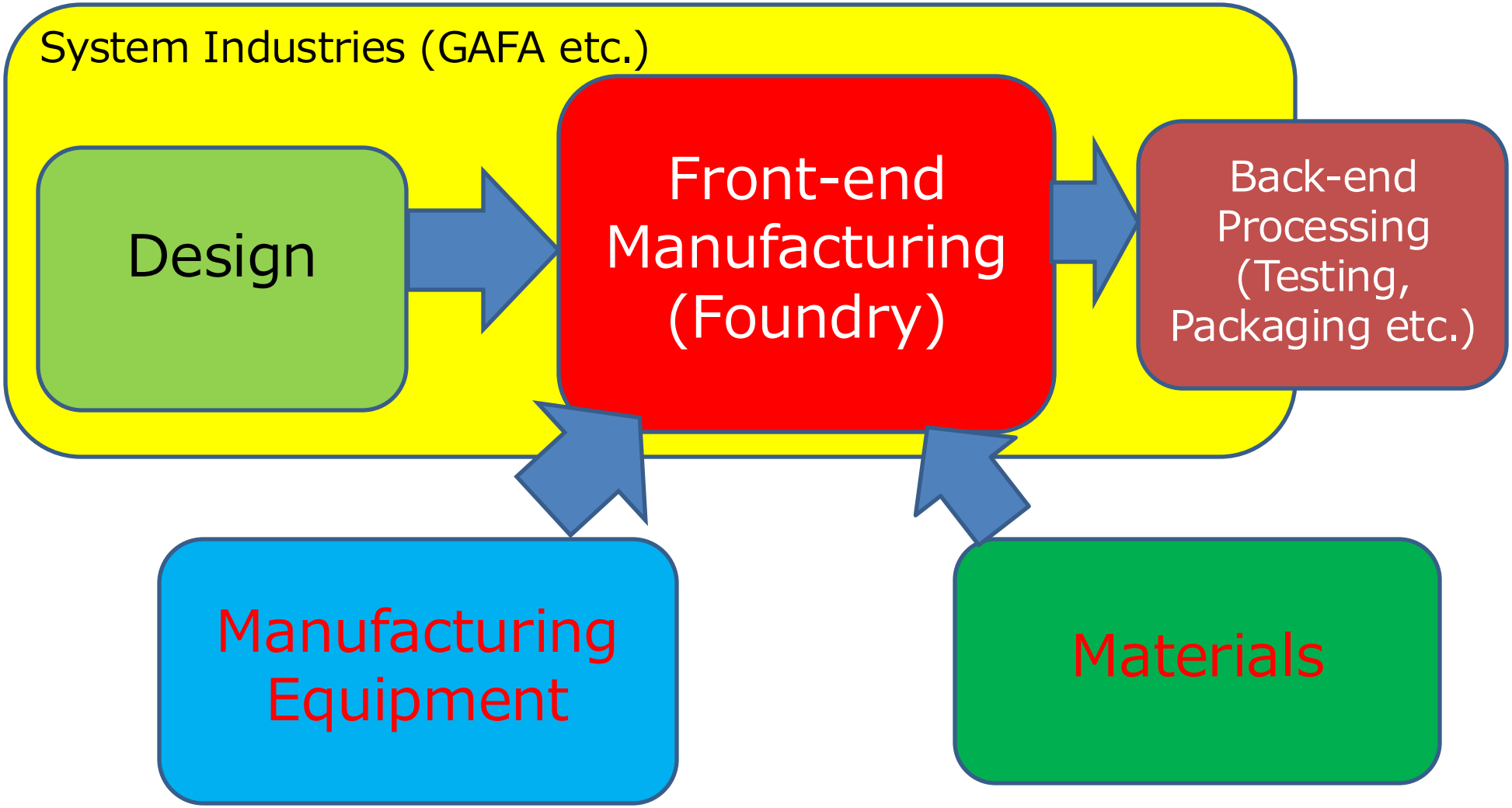
What Kyushu was lacking

- Capital
- Human Resources
- Research and Development Functions

What Kyushu was lacking

- Capital
  - Most Japanese semiconductor companies are IDMs (located in Tokyo)
  - IDM's continue the business model of 20 Century and dropped out of the investment race of advanced manufacturing technology (<40nm)
  - Still believing manufacture oriented business model
  - Few investment in Design (METI)

Supply Chain of Semiconductors



IDM and Design House

Semiconductor products revenue distribution (2022)

US$	USA.	Taiwan	Korea.	EU.	Japan.	China.	Others	Total
單位：億美元	美國	台灣	韓國	歐洲	日本	中國	其他	合計
Design House	1,355	398	28	30	18	315	10	2,154
IDM	1,502	81	980	476	448	90	20	3,597
半導體營收	2,857	479	1,008	506	466	365	30	5,751
Design House	24%	7%	<1%	<1%	<1%	5%	<1%	38%
IDM	26%	1%	17%	8%	8%	2%	<1%	63%
半導體產品營收佔比	50%	8%	18%	9%	8%	7%	<1%	100%

註：營收佔比合計超過 100%係因四捨五入計算結果所致。

資料來源：DIGITIMES Research，2023/1

What Kyushu was lacking

- Human Resources
  - There are good Universities and Technical Collages in Kyushu but students are going to automotive and software industries.
  - Declining semiconductor industries in these 2 decades, few students try to work in semiconductor.
  - Lack of people understanding global view of semiconductor industry.

Problems of Human Resource

Problems in Japan especially in Kyushu

- Lack of talents who understand the overall picture of the semiconductor industry.

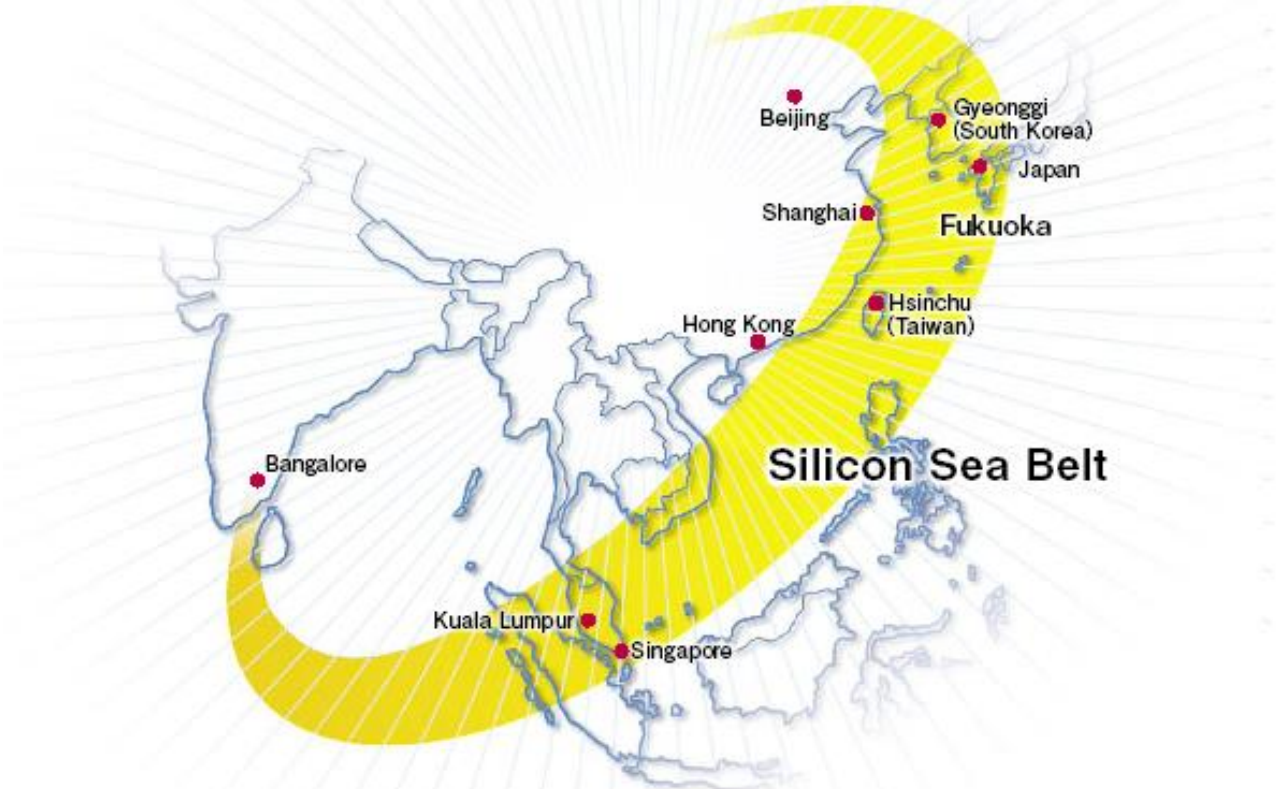
- Negative images of the semiconductor industry
  - Few young people see the value in dedicating their lives to the semiconductor industry.
  - People cannot take pride in the semiconductor industry.

- Few educational programs for researchers, specialists, and engineers in the semiconductor industry
  - No courses of Semiconductor in graduate schools, universities, and technical colleges
  - No primary and secondary education (Basic knowledge)
  - A few reskilling education for working people

What Kyushu was lacking

- Research and Development Functions
  - Research fundings from government are mainly concentrated in the manufacturing technologies and Materials. Few money for design and test area.
  - Silicon is not attractive for academia.
  - Education system for R&D people is not established.

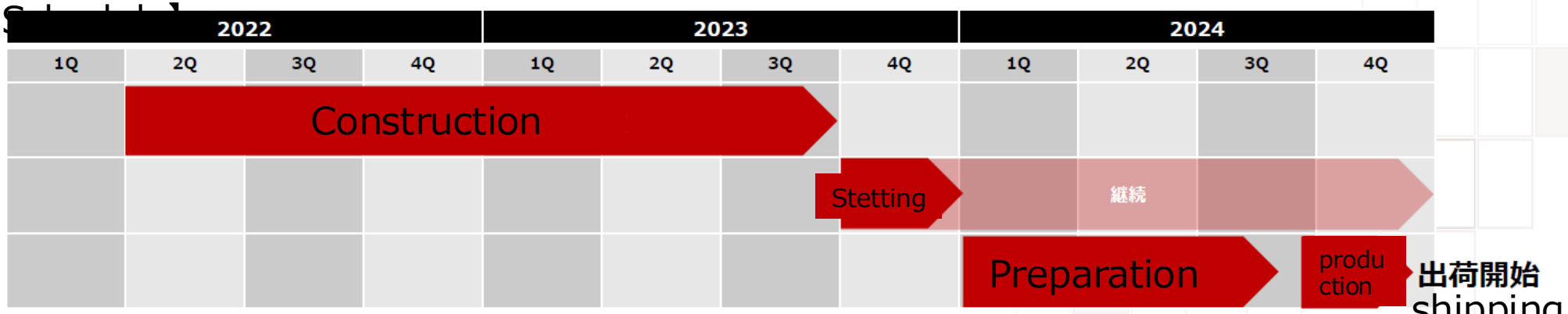
3. Challenges: Kyushu is now moving to reproduction



JASM (Japan Advanced Semiconductor Manufacturing)

- Established on Dec. 10, 2021
- Location: Kikuyou, Kumamoto Pref.
- Shareholders : TSMC,
  Sony semiconductor, Denso etc.
- 1st Plant: 23.1ha,
  22/28nm and 12/16nm Process
  55,000 wafer/month
  The first lot (4Q of 2024)
- A plan of 2nd Plant has been already announced

【Schedule】



Kyushu is now changing

- Capital
  - Investment from TSMC and Japanese Government.
  - Related industries started to invest.
- Human Resources
  - International standard salary
- R&D Functions
  - New courses of semiconductor R&D
  - Reskilling course for working engineers

Human Resource Development

Kyushu Semiconductor Human Resource Development Consortium

- Collaboration of Industries, Academia, and Local Governments

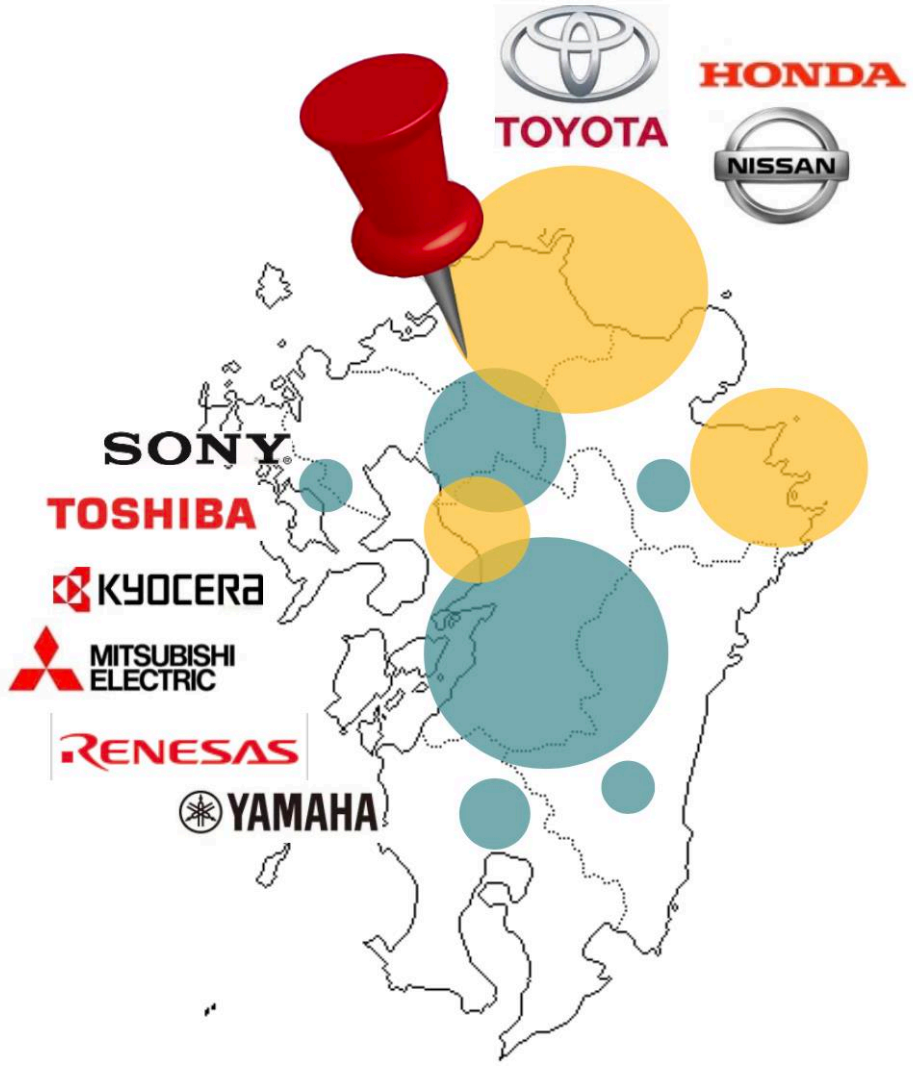
- Clarifying Kyushu's role in the global semiconductor industry structure and demand
- A semiconductor industry strategy that young people can bet their lives
- The provision of continuous learning opportunities for students through to working people
- Continuous investment in human and economic capital by building semiconductor eco-system

Actions

1. Teachers and Professors Training Seminars
   - Teachers in Elementary, Junior-High and High Schools
   - Professors in technical Colleges and Universities
   - Learning of overview of semiconductor Industry
   - Factory Tour
2. Semiconductor Curriculum in Technical Colleges
3. Top Engineer Education Programs in Grad. Schools
   - Collaboration with Taiwan top Universities
   - Kyushu Univ., Kumamoto Univ., Kyushu Inst. of Tech etc.
4. Reskilling Programs for Active Engineers
   - Fukuoka Semiconductor Reskilling Center
   - Center for Microelectronics Systems in Kyushu Inst. Tech.

Advantage and Resources (1)

- IDM Players
  Sony, Mitsubishi, Renesas, Rohm, etc.
- Automotive Industry and various users of Semiconductors
  Toyota, Nissan, Honda, etc.
- 9 National Universities with Engineering School and 8 National Technical Colleges
  # of Students with Science/Engineering background from Universities and Technical colleges is 26,530/year in Kyushu.

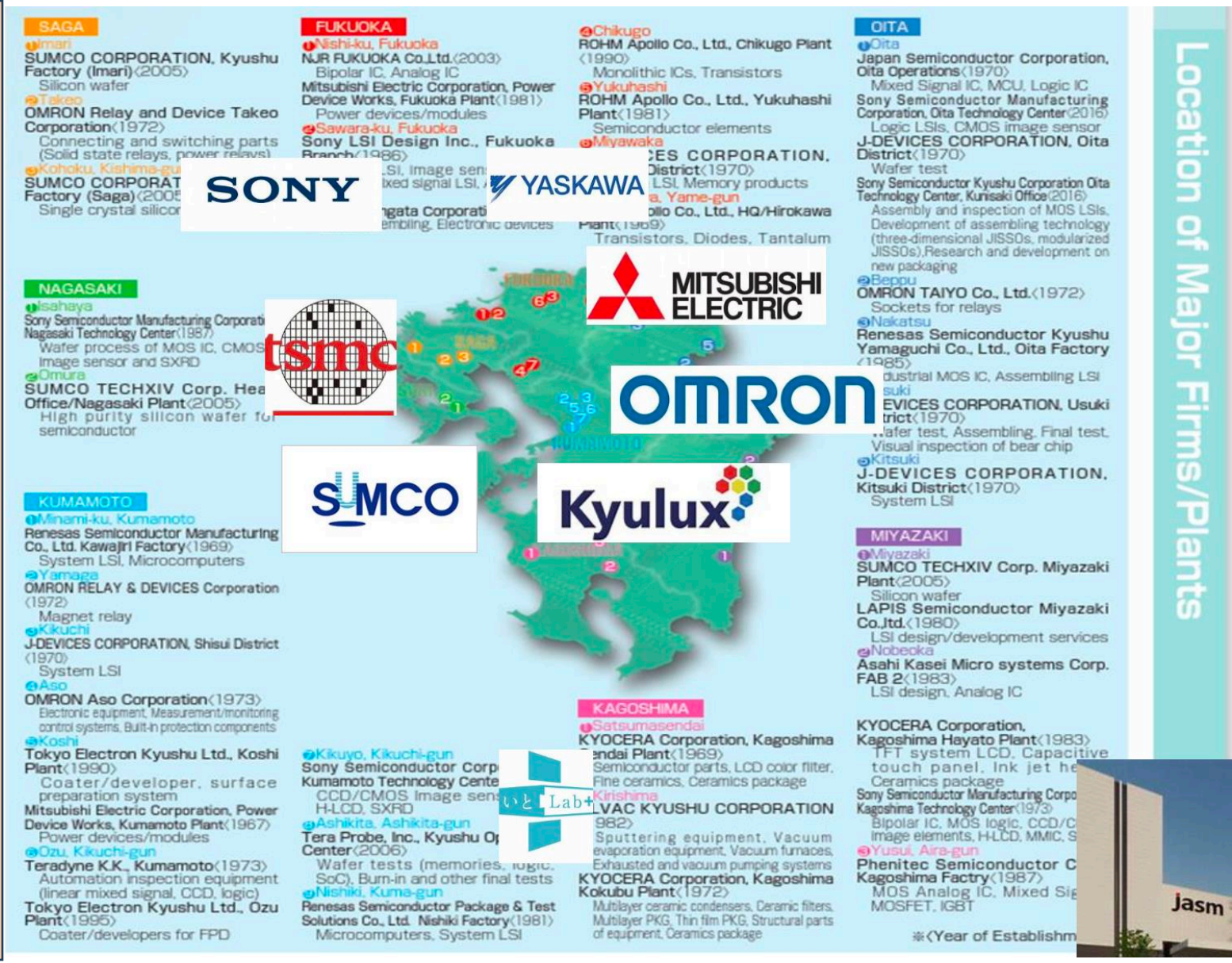


Advantage and Resources (2)

More than 1,000 companies related with semiconductor industries.

- Design
- Fabrication
- Packaging
- Testing
- Equipment
- Materials

SIIQ: https://siiq.or.jp/

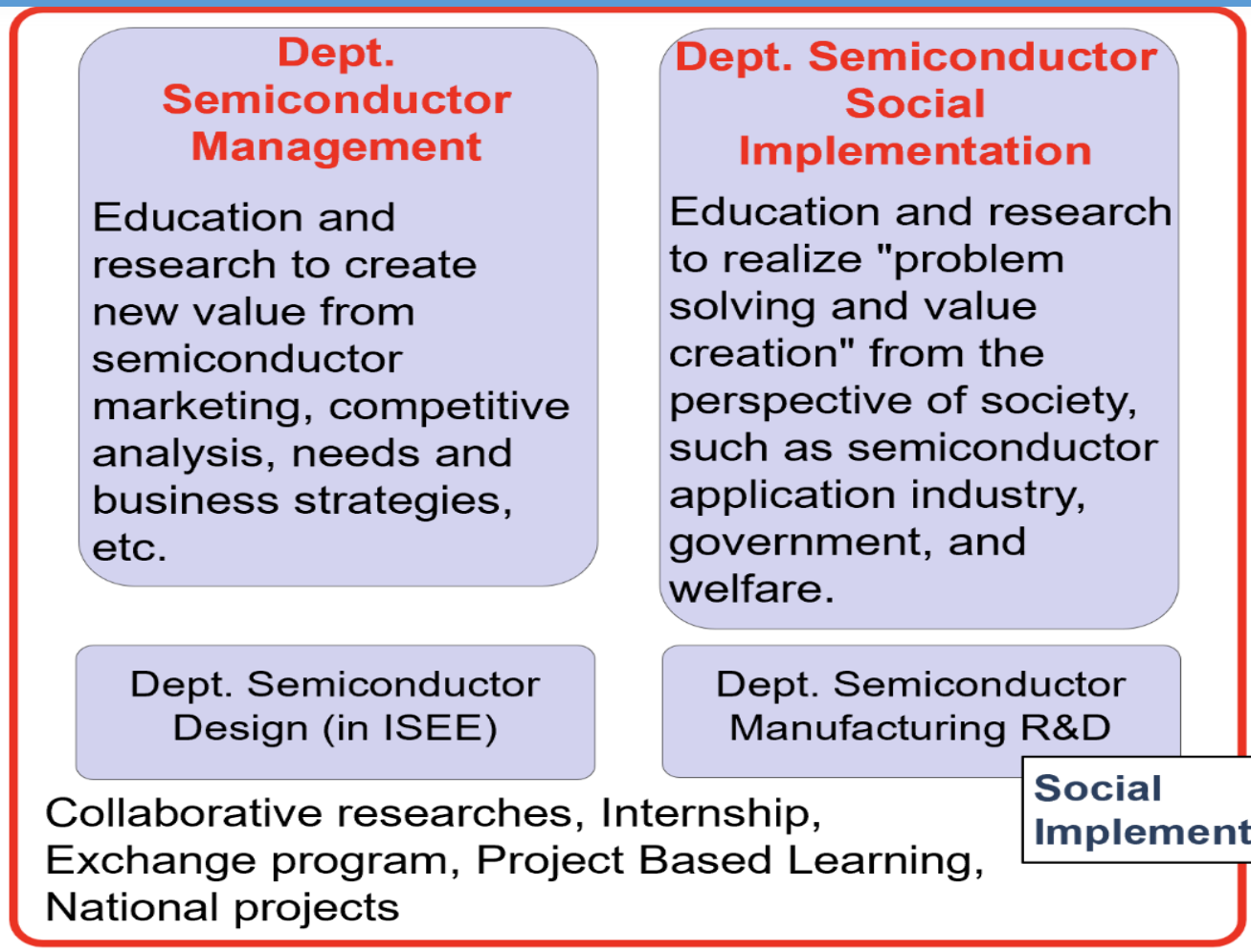


Education Center for Semiconductors and Value Creation (Kyushu University)

Education for
- Grad. And Undergrad.
- Other Universities
- Working people

Internship

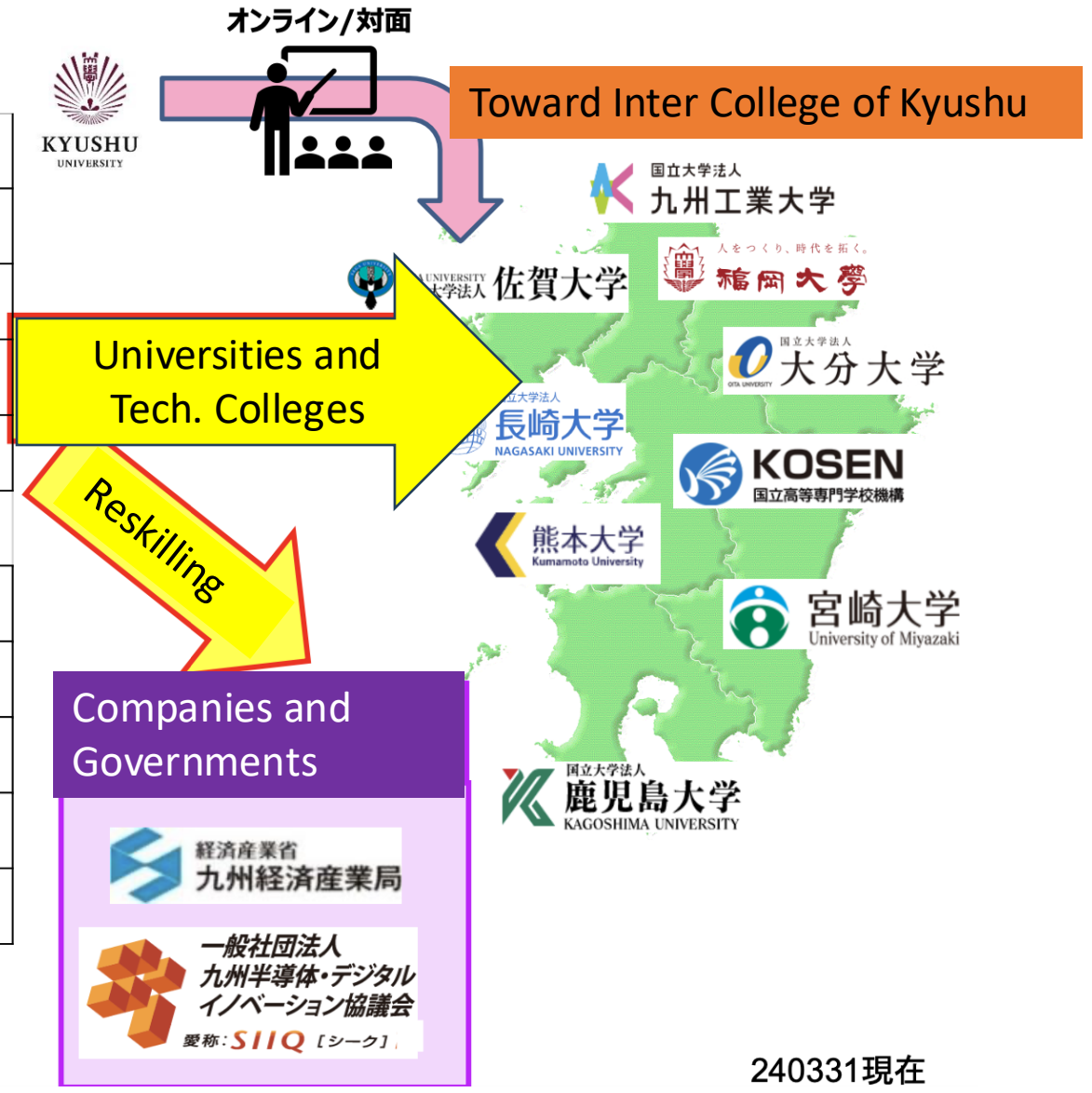
https://ecsvc.ed.kyushu-u.ac.jp/en/index.html



Open Courses

Advanced topics in sustainability and semiconductors 持続可能半導体特論
Advanced seminar of semiconductor business strategy 半導体ビジネス戦略特論
Advanced semiconductor technology marketing 半導体技術マーケティング特論
Advanced semiconductor technology management 半導体経営学特論
Advanced semiconductor social implementation 半導体社会実装学特論

Introduction to sustainability and semiconductors 持続可能半導体概論
Semiconductor business overview 半導体ビジネス概論
Semiconductor technology map 半導体技術マップ
Introduction to semiconductor technology management 半導体技術経営概論
Introduction to semiconductor social implementation 半導体社会実装概論



Advanced Technology Course by TSMC

- 講義名：Advanced CMOS Technology
- 春学期　金曜日　16:40－18:10
- **TSMC/JASM/TSMC-JDCの研究者・技術**
  よる8回の講義、1単位（修了要件）
- 「価値創造型半導体スペシャリス[redacted]ラム」対象科目
- 講義内容：最先端の半導[redacted]導体プロセス、集積回路設計、[redacted]
- 英語スライドに[redacted]講義
- 九州域内の[redacted]立大）にオンライン配信
- 他大学[redacted]には価値創造型半導体人材育成[redacted]修了証を授与

受講大学：九州工業大学、福岡大学、佐賀大学、長崎大学、熊本大学、大分大学、宮崎大学、鹿児島大学
※各大学は担当教員の管理の元、講義室等の学内施設で受講

International Collaborations

TEL

UPWARDS

U.S.: MICRON, TEL, 6 US Universities and 5 Japanese Universities

U.S.-Japan University Partnership for Workforce Advancement and Research & Development in Semiconductors (UPWARDS)

Taiwan: NYMCTU, NTU, ITRI, TSMC, CMSC

CMSC

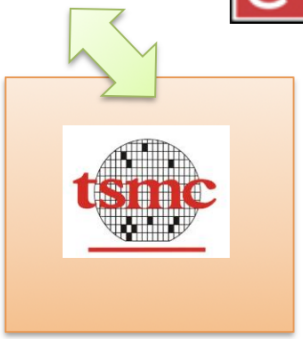
学術交流協定

連携協定

國立陽明交通大學
NATIONAL YANG MING CHIAO TUNG UNIVERSITY

ITRI
Industrial Technology Research Institute

國立臺灣大學 National Taiwan University



2024年4月1日

Deeptech Workshop

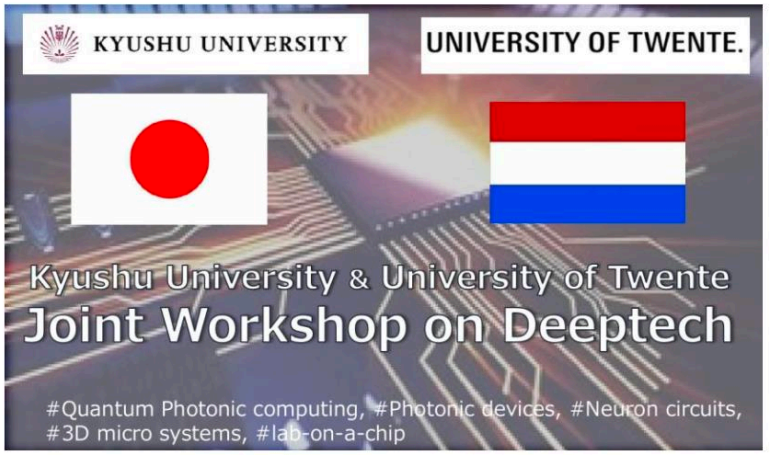
1st. Kyushu University – Twente University Joint Workshop

Focus of government and large companies on Deeptech has aroused interest in studies in this area and promotes closer relationship between Japan and the Netherlands. This joint workshop brings together young scientists from Kyushu University and University of Twente to delve into Deeptech related studies and their applications.

Date & Time：6 September (Fri.), 2024 9:00-11:10 (CET) 16:00-18:10 (JST)
Venue：Online (Zoom)
Topics：Quantum Photonic computing, Photonic devices, Neuron circuits, 3D micro systems and lab-on-a-chip
All invited presenters：PHD, MC
Target：Faculty and students from Kyushu University and University of Twente

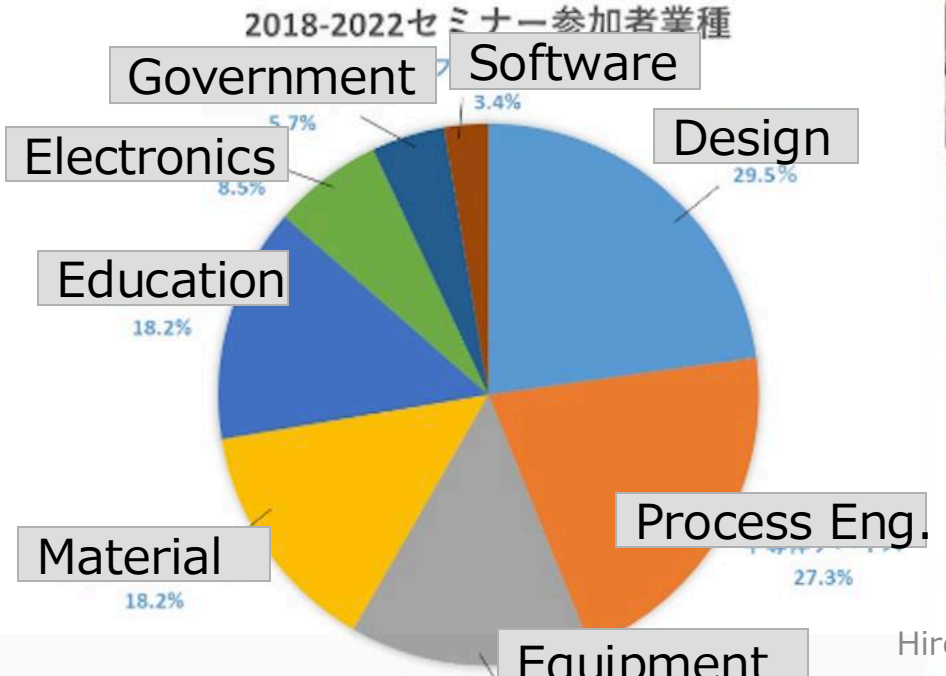
DEEPTECH DELEGATION
JAPAN TO THE NETHERLANDS
Semiconductors, Quantum Technology and Photonics
18-22 March 2024

Ministry of Economic Affairs and Climate Policy
Netherlands Enterprise Agency
High Tech NL
Quantum Delta NL
PhotonDelta
BOM
BRAINPORT EINDHOVEN
East Netherlands Development Agency
oost nl
noviotech campus
CHIPTECH TWENTE



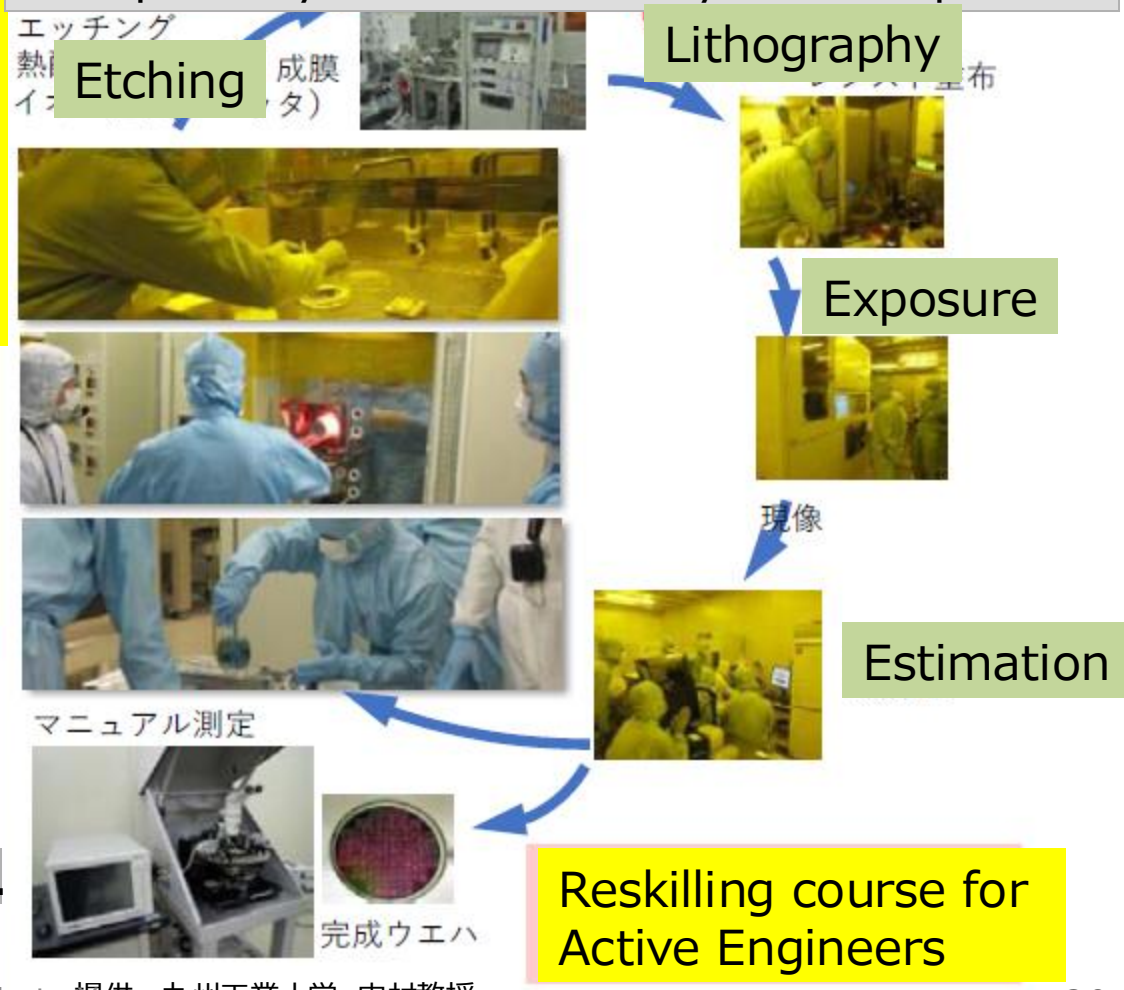
4 days course for CMOS Processing

- **1 Course in every month**
- **On-Site 14 (¥149,800)**
- **Online 50 (¥83,200)**
- **Special Program over 50**
- **https://www.cms.kyutech.ac.jp**
- **More than 1,000 Trainee in 2023**



Overall experience using old technology

- 4 inchi Wafer
- 1-μm Polysilicon Gate 1 layer metal process



提供：九州工業大学　中村教授

Research Activities

- Kyushu University
  - Plasma Engineering, IoT Chip Architectures, RF Circuits, Quantum computation etc.
- Kyushu Institute of Technology
  - Test technology, Medical Applications etc.
- Fukuoka University (Private Univ.)
  - 3D Packaging, 3D LSI, Circuit design
  - Research Center for Three-Dimensional Semiconductor (Collaborated with Fukuoka Prefecture)

  http://jiss.ist.or.jp/semiconductor.html
- Kumamoto University
  - Fabrication Technologies, LSI Design

  https://ewww.kumamoto-u.ac.jp/en/centers/researchorganizations/Semiconductors/

The 1st SEMICON Kyushu, Sept. 25,26

九州初！半導体産業に特化した専門展、開催決定！

第1回

会期：2024年9月25日(水)・26日(木)

会場：マリンメッセ福岡

主催：[九州]半導体産業展 実行委員会

後援：経済産業省 九州経済産業局、
(一社)九州半導体・デジタルイノベーション協議会、
福岡県、大分県、沖縄県、鹿児島県、熊本県、佐賀県、
長崎県、宮崎県、山口県、福岡市、北九州市、
(公財)福岡県産業・科学技術振興財団、
(公財)福岡県中小企業振興センター、(公財)大分県産業創造機構、
(公財)かごしま産業支援センター、(公財)くまもと産業支援財団、
(公財)佐賀県産業振興機構、(公財)長崎県産業振興財団、
(公財)ひろしま産業振興機構、(公財)宮崎県産業振興機構、
(公財)やまぐち産業振興財団、(公財)九州先端科学技術研究所、
(公財)北九州産業学術推進機構、
(国研)産業技術総合研究所 九州センター、(一社)九州経済連合会、
(一社)日本電子回路工業会、KOTRA・韓国貿易センター(福岡)

特別協賛：(株)西日本シティ銀行

2024.10.17

Exhibitors: 261 Organizations
Participants : 7.314 including 514 Students
https://k-semi.jp

Creating a Bridge between Tiwan and Kyushu

Conclusion

- Kyushu is now challenging to recover from long tunnel in semiconductor business area.
- Human resource development is a key issue of the movement.
- Collaboration with Taiwan, US, Korea and South-East Asian countries are required in the various levels. (Governments, Industries, Accademia and Societies)
- Remember the concept of Silicon SeaBelt and make it the upper version.

Kyushu is starting Silicon SeaBelt 2.0 for reproduction of Silicon Island again!